GPU-Accelerated Sparse Matrix Solvers for Large-Scale Simulations

EM Photonics

Technical Abstract

At the heart of scientific computing and numerical analysis are linear algebra solvers. In scientific computing, the focus is on the partial differential equations (PDEs) that arise from computational fluid dynamics (CFD), climate modeling, astrophysics, and structural and heat analysis that cannot be solved analytically. Certain problem formulations lead to sparse matrices, in which the majority of matrix elements are zero. Special attention is required when computing on sparse matrices in order to avoid using unrealistic amounts of memory or produce ill-performing software. Such topics have been the subject of considerable research and the limits of CPU-based performance have been reached. Recently, the graphics processing unit (GPU) has emerged as an attractive platform for high performance computing. The modern GPU boasts over 1 TFLOPS performance and as much as 6 GB onboard memory, but harnessing the power can be challenging. A library-based approach is common for HPC, with most applications using several libraries to offload well-known tasks. EM Photonics maintains a library of GPU-accelerated dense linear algebra solvers that has over 5000 users. In this project we will extend this library to include a wide range of sparse solvers, including many that have direct relevance to NASA projects.

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A Sensor Management Tool for Use with NASA World Wind

Intelligent Automation, Inc.

Technical Abstract

The number of sensors that are deployed continues to increase for scientific, commercial and intelligence related applications. Quantities of sensor data are increasingly available. NASA and NOAA are generating large quantities of sensor data involving earth, oceans and weather observations. US intelligence and commercial endeavors are also generating vast amounts of sensor data, gathered from sources ranging from satellites to vehicles. Standards have been developed that assist in making the large volume of sensor data usable. The Open Geospatial Consortium (OGC) has developed a number of specifications related to Sensor Web Enablement. OGC working groups are not only science-focused; the newest working group that is forming is an Emergency and Disaster Management Discipline Working Group (DWG). Intelligent Automation Inc (IAI) is proposing to support the data access and utilization needs of the individual researcher / scientist and the emergency incident commander through development of the Sensor Management Tool (SMT). SMT is standards-based, open source and will offer configurable views for different categories of users. In the Phase I effort IAI demonstrated feasibility and prototyped the SMT concept; this involved integration of NASA World Wind to extend SMT functionality. 'Lessons learned' provide input into our detailed plan for full-featured SMT development.

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